latitude of anticyclones in the previous winter, this giving 0.54. This lack of result for the summer may be due to the fact that the rainfall in this season often occurs in heavy thundershowers and the variations are more irregular than in other seasons.

The temperature does not show such high correlations as the rainfall for any season, but the winter temperature compared with the trend of the anticyclones in autumn gives a coefficient of 0.71. Some results obtained lately, and which will be published in the near future, indicate that the difficulty to obtain a large correlation with the temperature is due to the complication set up by the effect of cloudiness on temperature.

It is probable that the shifting south of the barometric depressions in some seasons and of anticyclones in other seasons and the trend of the latter to move north or over the ocean are really indications of one and the same phenomenon, which may be an increased energy of the equatorial air currents as opposed to the polar air currents.

It is noteworthy that these trends of depressions and anticyclones do not show any marked correlation with the barometric pressure variations in Argentina, though it is possible they might show it with the pressure of the equatorial region of Brazil.

Further researches are being conducted along these lines, and it is hoped they may give not only practical results for seasonal forecasting, but may also throw light on some problems of the general circulation of the atmosphere and the cause of abnormalities of certain seasons.

NOTES AND ABSTRACTS

THE MASS EXCHANGE IN THE FREE AIR AND RELATED PHENOMENA[1]

The study of atmospheric turbulence has nowadays grown to a very live branch of meteorology, with numerous applications in different fields. In this development W. Schmidt, in Vienna, has played one of the foremost parts, being one of the creators of the fundamental conception "Austausch" (exchange) upon which the theory of atmospheric turbulence tests. Schmidt has made it his task to prove the fertility of this conception in a number of problems also outside pure meteorology. It is therefore most gratifying that a monograph from his hand has appeared which in a popular way treats the question of the turbulent exchange of mass in the atmosphere as well as a number of its geophysical and geographical botanical consequences.

The chief effect of the exchange of mass through a fixed horizontal unit surface in the atmosphere is, as well known, that any element the vertical distribution of which is not uniform will be subject to a vertical transport or diffusion. This transport or flow upward per square centimeter and second is equal to the product of a coefficient, A, in the rate of decrease upward of the element under consideration. The first of these factors, the "Austausch," depends solely upon the rate of mass exchange and is independent of the element discussed. The second factor depends only upon the element discussed and is independent of the mass exchange.

The above expression for the diffusion can now be applied to any property of the air that remains constant during adiabatic compression and expansion; for instance, horizontal momentum, potential (not ordinary) temperature, water vapor content (in absence of condensation), electric charge, content of dust, condensation nuclei, seed, and pollen. The theory can, of course, also be applied to turbulence in the sea. Schmidt treats in his book the effect of turbulent mass exchange on all these elements and on a number of others not mentioned here.

In the section devoted to the vertical temperature distribution, Schmidt has subjected the diurnal variation of temperature at different levels to a very illuminating study. It is shown how the actually observed oscillations are composed of two terms, one depending upon the diurnal variation of absorption and emission of radiation at that level, while the second term represents the temperature variation at the surface which is propagated upward with decreasing velocity and amplitude.

The same section also discusses the difference between continental and maritime climate. It is shown that the usual explanation of the difference between these two climatic types, which is based upon the difference between the thermal capacities of water and soil, is very unsatisfactory. The specific heat per unit volume of water is only about twice that of the soil; if the soil and the water otherwise behaved in the same way, this difference would produce a ratio of the amplitudes of the diurnal temperature variations equal to $\sqrt{2}:1$, while the actually observed ratio is many times larger. The true explanation lies in the *turbulence* of the sea, which rapidly carries the heat accumulated at the water surface downward to deeper strata. In the ground there is no such turbulence; only the extremely small molecular conduction of heat is active, at a very slow rate carrying accumulated heat downward, but leaving the greater part of it to be reradiated to the lowest atmospheric layers.

It is impossible in a short review to mention all the questions which lend themselves advantageously to a treatment by the Austausch method. Schmidt makes, after Richardson, comparisons between the upward transport of water vapor and the precipitation; these two quantities must become equal when means are formed over the globe and for a long period (for instance a year).

There is in Schmidt's book one application of the theory of turbulent diffusion, which as far as I can judge should be of the greatest value to botanists and geographers; namely, the spread of pollen and seed by wind and turbulence. Using a mean wind velocity of 6 meters per second, an "Austausch" value of 20 units, and taking into account variations in velocity of free fall for different kinds of seed and pollen, Schmidt is able to compute for each a "mean dispersion limit." He arrives at the following values:

	Kilometers
Spores of *Lycoperdon*	460, 000
Pollen of *Pinus silvestris*	40
Seed of *Taraxacum officinale*	10
Seed of *Betula verrucosa*	1. 6

The mean dispersion limit is defined as the distance from the plant beyond which less than one one-hundredth of the seed or pollen will reach.

Other chapters in the book are devoted to questions relating to atmospheric electricity, vertical wind distribution, dissipation of energy in the atmosphere, etc. The book is pleasingly written and deserves all attention from meteorologists and others interested in atmospheric phenomena.—*C. G. Rossby.*

[1] Der Massenaustausch in freier Luft und verwandte Erscheinungen, von Dr. Wilhelm Schmidt, Hamburg 1925. (Probleme der Kosmischen Physik, VII.)